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Humanism and History of Mathematics

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Hypatia of Alexandria

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The first woman mathematician regarding whom we have positive knowledge is the celebrated mathematician-philosopher Hypatia. The exact date of her birth is not known, but recent studies indicate that she was born about A. D. 370 in Alexandria. This would make her about 45 years of age at her death. Hypatia, it seems, was known by two different names, or at least by two different spellings of the same name; the one, Hypatia; the other, Hyptachia. According to Meyer,¹ there were two women with the same name living at about this time; Hypatia, the daughter of Theon of Alexandria; the other, the daughter of Erythrios. Hypatia's father was the well-known mathematician and astronomer Theon, a contemporary of Pappus, who lived at Alexandria during the reign of Emperor Theodosius I. Theon, the director of the Museum or University at Alexandria, is usually considered as a philosopher by his biographers.

Hypatia's biographers have given us but little of her early personal history. We know that she was reared in close touch with the Museum in Alexandria, and we are probably safe in assuming that she received the greater part of her early education from her father. If we are to judge from the records which the historians have left us, we would conclude that her early life was uneventful. It would seem that she spent the greater part of her time in study and reading with her father in the Museum.

Suidas² and Socrates,³ as well as others who lived at the same time, lead us to believe that Hypatia possessed a body of rare beauty and grace. They attest not only to her beauty of form and coloring, but each and every one speaks just as highly of the beauty of her charac-

¹ Meyer, Wolfgang Alexander, *Hypatia von Alexandria*, Heidelberg, 1886, pp. 52.

² Socrates, *The Ecclesiastical History*, Trans. by Henry Bohn, London, 1853.

³ Suidae, *Lexicon, Lexicographi Graeci*, Vol. I, Pars IV, ed. Ada Adler, Lipsiae, 1935.



*Gasparo's portrait of
HYPATIA
(reproduced by permission of the copyright owners of "Little Journeys")*



*Medallion of Hypatia in the Introduction to Halma's edition
of Theon's "Commentary". (Artist unknown)*

ter. In the absence of a life painting of Hypatia we must depend upon the conception of others for a picture of the philosopher. In the introduction to his edition of Theon's Commentary¹ Halma has given us a short biography of Hypatia. On the title-page there is a medallion which gives his conception of the philosopher. Meyer feels that this drawing is unfortunate, as he does not believe it gives a true impression of the woman Hypatia. Charles Kingsley, on the other hand, in his novel *Hypatia* has written a vivid description of his impression of the philosopher.

If we are to believe the historians as to her beauty, we would expect that she was eagerly sought after in marriage. This apparently was the case: her suitors included not only outsiders, but many of her students as well. The question of her marriage, however, leads us to one of the controversial points of her life. Suidas states she was the wife of the philosopher Isidorus; then 25 lines later, he states she died a virgin. This apparent contradiction has been explained in several ways by later writers.

Toland² believes she was engaged to Isidorus before she was murdered, but was never married. Hoche³ is of the opinion that the mistake arose from Suidas' abstract of the works of Damascius, a conclusion which Meyer does not believe to be true, pointing out that he found on the margin of one of Photius' works the statement, "Hypatia, Isidore uxor." Since Photius transcribed Hesychius' works, it is possible that the error arose in this manner. The evidence against such a marriage is further substantiated by the fact that Damascius states that Isidorus was married to a woman named Danna and had a child by this wife. Another fact which should be taken into consideration is that Proclus was much older than Isidorus: it has been pretty definitely established that Proclus was born about 412, and, since Hypatia's death occurred in the year 415, it would be impossible for Hypatia to have been the wife of Isidorus. The present writer is inclined to agree with Meyer that the mistake arose in Photius' transcription of Hesychius' work and that Hypatia was not married at any time in her life.

The second controversial point is the question of her death. In studying the statements made by many of the historians in regard to her death it seems desirable to review the murder in relation to the events which had happened previously. It is necessary for us to

¹ *Theon d'Alexandrie, Commentaire sur le livre III de l'Almageste de Ptolemee*, ed. Halma, Paris, 1882.

² Toland, John, *Tetradymus*, London, 1720, pp. 101-136.

³ Hoche, Richard, *Hypatia die Tochter Theons*, Philologus, Fünfzehnter Jahrgang, Göttingen, 1869, pp. 435-474.

investigate not only Hypatia's relation to paganism, but also the relation between Cyril, the Christian bishop at Alexandria at this time, Orestes, the Roman Governor at Alexandria, and Hypatia. In view of this triangular relationship, we shall recall briefly some of the important events just prior to and during the episcopate of Cyril and their relationship to the authority of the Roman Governor.

On October 12, 412, Theophilus, the Bishop at Alexandria, died, and six days later his nephew Cyril was elevated to the episcopate of Alexandria. From the outset the new bishop began to enforce with zeal the edicts of Theodosius I, the Roman Emperor, against the pagans, along with restrictions which he himself promulgated against the Jews and unorthodox Christians. He further began to encroach upon the jurisdiction which belonged to the civil authorities; that is, to the Roman Governor. It must be remembered that the population of the city of Alexandria in the fourth and fifth centuries of the Christian era consisted of a conglomeration of nationalities, creeds, and opinions, and that nowhere in the Empire did the Romans find a city so difficult to rule as Alexandria. The people were quick-witted and quick-tempered, and we read of numerous clashes, street fights, and tumults, not only between the citizenry and the soldiers, but also between the different classes of citizens themselves. There were frequent riots between the Jews and the Christians on the one hand and the pagans and the Christians on the other. The Christian population did little or nothing to quiet these people, but even added one more controversial topic for them to quarrel about. Consequently we find that the edicts and promulgations of Cyril not only caused strife among the people but aroused the anger of the Roman Governor, Orestes, the one person who stood in the way of the complete usurpation of the civil authority by Bishop Cyril. Friction continued between these two until there was a definite break in their relations.

Because of her intimacy with Orestes, many of the Christians charged that Hypatia was to blame, at least in part, for the lack of a reconciliation between Orestes and Cyril. Socrates states that some of them, whose ringleader was named Peter, a reader, driven on by a fierce and bigoted zeal, entered into a conspiracy against her. They followed her as she was returning home, dragged her from her carriage, and carried her to the church *Cæsareum*, where they stripped her and then murdered her with shells. They tore her body to pieces, took the mangled limbs to a place called *Cinaron*, and burned them with rice straws. This brutal murder happened, he says, under the tenth consulate of Honorius and the sixth of Theodosius in the month of March during Lent, so that the year of her death may be set as 415.

Socrates' report of Hypatia's death is corroborated not only by Suidas, but also by other historians such as Callistus,¹ the ecclesiastical historian, Philistorgus,² Hesychius³ the Illustrious, and Malalus.⁴ Damascius says that Cyril had vowed Hypatia's destruction, while Hesychius states that his envy was caused by her extraordinary wisdom and skill in astronomy. Damascius also relates that at one time Cyril, passing by the house of Hypatia, saw a great multitude, both men and women, some coming, some going, while others stayed. When he was told that this was Hypatia's house and that the purpose of the crowd of persons was to pay their respects to her, he vowed her destruction.

When we compare these statements, it would seem that Hypatia's death, or at least the occasion of it, was due to her friendship with Orestes. This friendship enraged the Christian populace because they felt that she prevented a reconciliation between Cyril and Orestes. We are also led to believe that the more sober-minded of the Christians yearned for a reconciliation between these two and that no doubt her death was ordered by Cyril.

Among the later writers on the subject there is a divergence of opinion. Toland lays the death of Hypatia directly at the feet of Cyril. Wolf⁵, on the other hand, is inclined to believe that Cyril knew beforehand that the murder was being plotted but did nothing to prevent it. As to the causes of the murder, Wolf mentions her belief in paganism and her teaching of Neoplatonism, along with the practice of treating the mentally diseased with music, all of which might be considered as coming under the pale of the edicts of Theodosius I regarding pagan worship.

The present writer is inclined to follow Meyer part of the way in the interpretation of these events; that is, Hypatia was used as a sacrifice for a political or personal vengeance, possibly a political vengeance. Cyril and Orestes were at odds; both had made various reports to the Emperor, each one attempting to show that his actions were justified. On the other hand, Orestes was the one person who stood in the way of the complete assumption of the civil power by Cyril, and naturally Cyril was eager to use every incident which would embarrass Orestes. In the case of Hypatia's death it would seem that its underlying cause was not so much a struggle for the assumption of the

¹ *Nicephori Kallisti historia ecclesiastica* Migne, *Patrologiae Graecae*, Tome 147, Paris, 1856.

² *Ex ecclesiastici Philostorgii historia epitome confecta a Photio patriarcha*, H. Valesio interprete, Paris, 1873.

³ *Hesychii Milesii Onomatologie que supersunt cum prolegomenis*, ed. J. Flacch, Lipsiae, 1882.

⁴ Malalae, Johannus, *Chronographia ex recensione Ludovici Dindorfii*, Bonnae, 1831.

⁵ Wolf, Stephan, *Hypatia, die Philosophin von Alexandrien*, Vienna, 1879.

civil authority, but rather a struggle of the Christian church against the pagan society of Alexandria. It must be remembered that although Orestes professed Christianity, the fact still remained that his profession was more one of policy than of faith. In all justice it would certainly seem that Cyril should be held at least indirectly responsible for her death. Certainly he could have prevented the mob's violence, if he had made the slightest effort.

Meyer feels the relation between Cyril and Synesius should be considered in investigating Hypatia's death. He is of the opinion that possibly there was an old difference between these two, and that her death was brought about by Cyril in order to settle this difference with Synesius. Meyer bases his conclusions on the contents of Epistle 12¹ of Synesius, in which he exhorts Cyril to go back to the Mother Church, from which he had been separated for a period of time for the expiation of sin. The present writer is of the opinion that Meyer has no justification for this assumption. Although we do not know the exact date of Synesius' death, it was probably between 412 and 414, and it must be remembered Cyril was not raised to the bishopric until late in the year 412. It is very probable that Epistle 12 was written before Cyril was made Bishop at Alexandria, though as a matter of fact we have no convincing evidence that the letter was written to Saint Cyril. Furthermore, there is no evidence to support the belief there ever existed any difference between Cyril and Synesius.

It has been stated above that little is known concerning Hypatia's early life. Consequently there is little on which to base our conclusions regarding her early education. It goes without saying that her father taught her in mathematics, astronomy, and science. Beyond this we do not know who her teachers were, but we may rest assured that, with an intellect as fertile as hers, she was not long satisfied with the narrow training in mathematics and astronomy. In order to understand the possible trend of her education it is necessary to take a look at the working of the Museum at Alexandria. The Museum had its origin in the efforts of Ptolemy Soter about 300 B. C., when he brought to the city of Alexandria all the philosophers and writers it was possible for him to obtain. To these he gave every encouragement possible, not only financial aid, but also in books and manuscripts from Greece. The later rulers of Egypt continued their support until the country came under Roman authority in 30 B. C. This ended the first period of intellectual activity, which is characterized as purely literary and scientific in nature. With the conquest of the country by the Romans, intellectual activity was again in the as-

¹ Synesii, *Opera quae extant omnia, Patrologiae, Graecae*, Tomus LXVI, Paris, 1864.

cendency and Roman, Greek, and Jewish scholars were again attracted to the city. This second school of thought was somewhat different from the first. We have an intermingling of nationalities with their varying philosophies and personalities all of which developed into the speculative philosophy of the Neoplatonist, the religious philosophy of the early Christian fathers, and the gnosticism of the Oriental philosophers. This second period of intellectual activity continued until about 642, when the city was destroyed by the Arabs. Considered as a whole, the Alexandrian School stood for learning and cosmopolitanism, for erudition rather than originality, and for a marked interest in all literary and scientific techniques. It was at the Museum that these philosophers, writers, and scientists gathered to lecture to their students and to converse with one another. Theon, Hypatia's father was director or fellow in the Museum, and it is reasonable to infer that Hypatia came into close contact with the leading educators and philosophers of Alexandria.

The question is frequently asked whether or not Hypatia studied at Athens. Here again we come to a point which has not been definitely decided. Suidas says she obtained part of her education there, or at least the passage has been so interpreted, for both Meyer and Hoche are of the opinion that Suidas has been misinterpreted on this point. Wolf states that Hypatia studied at Athens under Plutarch but Meyer again points out that this was highly improbable, as at the time Plutarch was lecturing at Athens, Hypatia was probably 30 years of age and was herself lecturing at Alexandria. Suidas also makes mention of the fact that she studied under another philosopher at Alexandria, but he does not identify this philosopher except to say that it was not Theon. Meyer thinks it might have been Plotinus. Regardless of how or where she received her education, we do know that she received a thorough training in arts, literature, science, and philosophy under the most competent teachers of the time.

It was with this training that she succeeded to the leadership of the Neoplatonic School at Alexandria. The exact date at which she assumed control of the school is not known, but Suidas informs us that she flourished under Arcadius, who was Emperor of the Eastern Roman Empire from 395 to 408. We are naturally led to ask two questions regarding her teaching: first, what was her ability as a teacher? second, what was the nature of her teaching? The first question is much simpler than the second, although there are sufficient facts relating to the nature of her teaching to enable us to draw a fairly definite conclusion.

All the contemporary and later writers on this period testify to the high reputation of her work as a teacher. Each one attributes an

extraordinary eloquence and an agreeable discourse to her lectures. Suidas speaks highly of her teaching methods, while Synesius in one letter praises her voice and in another mentions that her philosophy was carried to other lands. Socrates and Philistorgius tell us that not only the Egyptians, but students from other quarters of Europe, Asia, and Africa came to her classes until there was in reality a friendly traffic in intellectual subjects. Suidas states that, on account of her ability as a teacher and her personality, Orestes sought out her house to be trained in the art of public manners. Damascius states she far surpassed Isidorus as a philosopher, and it should be remembered that Damascius was a friend and pupil of Isidorus.

Among her disciples there are many well-known men other than Synesius. The names of these include Troilius, the teacher of the ecclesiastical historian Socrates, Euoptius, the brother of Synesius and probably the Bishop of Tolemais after the death of Synesius, Herculianus, Olympius, Hesychius, and finally Herocles the successor of Hypatia in the Platonic School at Alexandria.

From her teaching position she expounded the philosophy of the Neoplatonic School and her fame rests primarily upon the manner in which she conducted this school. In her teaching she no doubt lectured not only on philosophy as we know it today, but also included the scientific subjects of mathematics, astronomy, and the subject of physics as known at the time. She was apparently well versed in astronomy, since Suidas tells us that she excelled her father in this field. We may also assume that she taught the rudiments of mechanics, since there is a reference in one of Synesius' letters to an astrolabe which she constructed, and in another letter Synesius requests Hypatia to make a hydroscope for him.

Neoplatonism, as a philosophic system of thought, had its inception during the second century of the Christian era. It was built up from the remains of many of the systems of philosophies of ancient Greece and became a religion for many of the heathens, who could no longer believe in the old gods of Olympus. The Neoplatonist believed in a supreme being or power, which was the Absolute or One of the system. This supreme power was mystic, remote, and unapproachable in a direct fashion by finite beings. Hence there existed between man and the Absolute lesser gods or agencies. The first in this series was Nous or Thought, which was emanated by the Absolute as an image of itself. Below Nous there existed the triad of Souls, which pervaded all of the material universe, and all of those beings with which it is peopled are a direct emanation from the triad of Souls. Matter or material things were thought of as belonging to an evil category, while

the triad of Souls belonged to a pure category. Man, a mixture of the material and the spiritual, has the power by indulging in self-discipline and subjugation of the senses, to lift himself to a level where he may receive from the Absolute a revelation of divine realities. Once man has caught a glimpse of this vision, he is able to free himself entirely from the thrall of matter.

It should be noted that the development was from a higher to a lower or descending series. Since each series participated in the one above it, there was also a turning back, where the soul by an ascending process was able to return to the Absolute. The object of life, when the soul was perfectly free, was to rise by the practice of virtue from the category of matter to the higher category of intelligible realities. There were purifying virtues, which disciplined the soul till it became capable of union with the Absolute.

We have no writings of Hypatia, but we may rest assured that she at least subscribed to the general principles of Neoplatonism. Plotinus' works show that he succeeded in contempt of bodily cares and needs, and we find the same thing to be true with Hypatia. No doubt Hypatia's use of logic, mathematics, and the exact sciences gave her a discipline which kept her and her pupils from going too far in the superstitions and speculations of some members of this group of thinkers. Synesius in his speech before the Arcadians, acknowledges the purely subjective character of the different attributes which are conceived of by man as belonging to the divine nature. He also felt a wholesome reticence in his attempts to reach towards the Incomprehensible. He believed in the Trinity of Plotinus, but did not assign to the World-soul the creating or animating of the entire universe. He thought occasional supernatural communications between God and the human soul were possible, and he also believed that man was able to purify his soul to such an extent that he would be able to elevate the imagination to a point where it would be possible for him to share in the ecstasy of the upper light. He believed that the final goal aimed at in life was a pure and tranquil state of mind, undistracted by fierce passions, gross appetites, or the demands of worldly affairs. It would be reasonable to assume that these tenets of Synesius' faith were inculcated in him by his beloved teacher Hypatia.

In considering the writings of Hypatia we have but little information to fall back on. Suidas is the only historian to give us any information concerning her writings. He gives us the names of three: a commentary on the *Arithmetica* of Diophantus of Alexandria, a commentary on the *Conics* of Apollonius of Pergassus, and a commentary on the *Astronomical Canon* of Ptolemy. None of these are extant at the present time.

We are naturally led to the question why Hypatia, a student of philosophy, a teacher of renown, and the leader of the Neoplatonic School at Alexandria, left only three works and those three purely mathematical or astronomical. The answer is probably that Suidas quoted the writings of Hypatia as given by Hesychius, who for some reason gives an account only of the Astro-Mathematical works of Hypatia. It is rather difficult for us to believe that with approximately twenty years of teaching she would produce not more than three works, and those three commentaries. So we are led to the conclusion that Hypatia did leave other writings, which were probably lost in the destruction of the library at Alexandria, and that these works were principally philosophic in nature. It is true that both Halma and Montucla¹ make mention of other works of Hypatia; Halma in particular says she left behind "beaucoup d'écrits". At the present time it is impossible to determine from what source Halma obtained this information, and it is more than probable this is only a conjecture on his part.

With the passing of Hypatia we have no other woman mathematician of importance until late in the Middle Ages. Although we have no definite information to indicate that she exerted any great influence on the development of mathematics or science in general, nevertheless she certainly passed on to her scholars and followers a discipline and restraint which were carried over to a later period. It is possible that the effects of her teachings have been lost sight of, since any works she might have left behind were certainly lost when the Arabs destroyed the Library at Alexandria in 640.

¹ Montucla, J. F., *Histoire des Mathématiques*, Tome I, Part I, Liv. V, Paris, 1799.

Due to causes that need not be explained here it seemed advisable to the Editor and Manager of the MAGAZINE to omit (a) the department of *Mathematical World News* from the October issue and (b) the *Problem Department* from this, the November issue. The latter department will be included, as usual, in the December and future issues.